

GENERAL POWER CONVERTER STARTUP

TEAM KILL-A-WATT

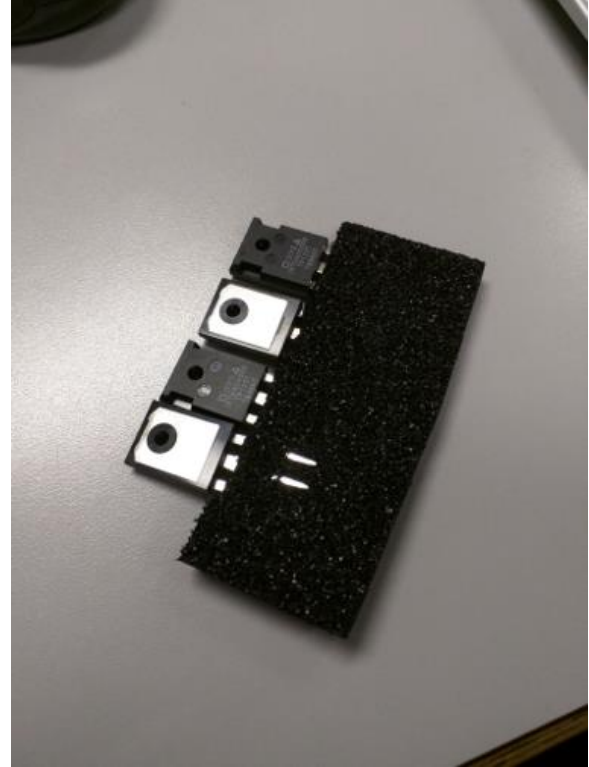


SEMESTER 1



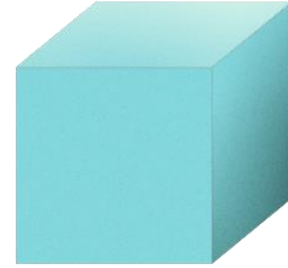
PROBLEM

- Heat powered converter controller
 - General purpose converter
- Cold starting the converter
 - Heat Thermal Electric Generators (TEGs)
 - Direct Power to Microcontroller



SPECIFICATIONS

- Setup/Startup: <12 hrs
- Power out: 1W to steady state
- Isolation at steady state
- Input: 100-600Vrms @ 0-400Hz
- Spatial: 0.5 m³ with system
- Weight: 2-man carry weight



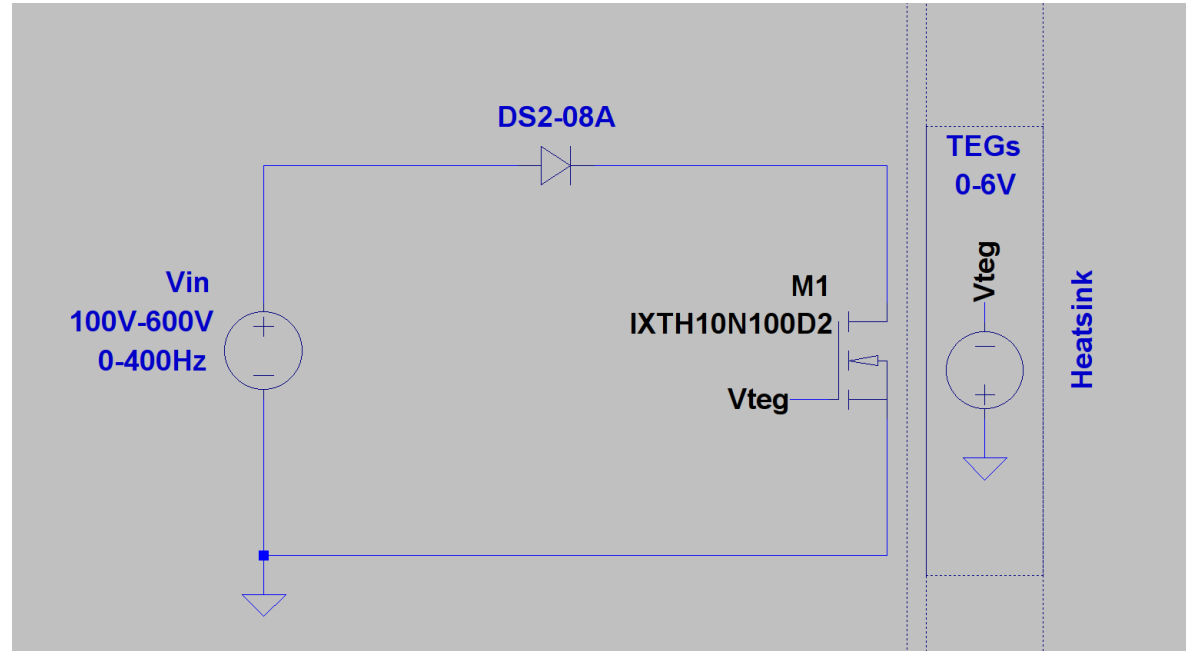
DESIGN A: PRE-HEAT TEGS

- Take advantage of TEGs
- Convert electrical power to thermal power
- Use TEGs' output as a feedback control mechanism



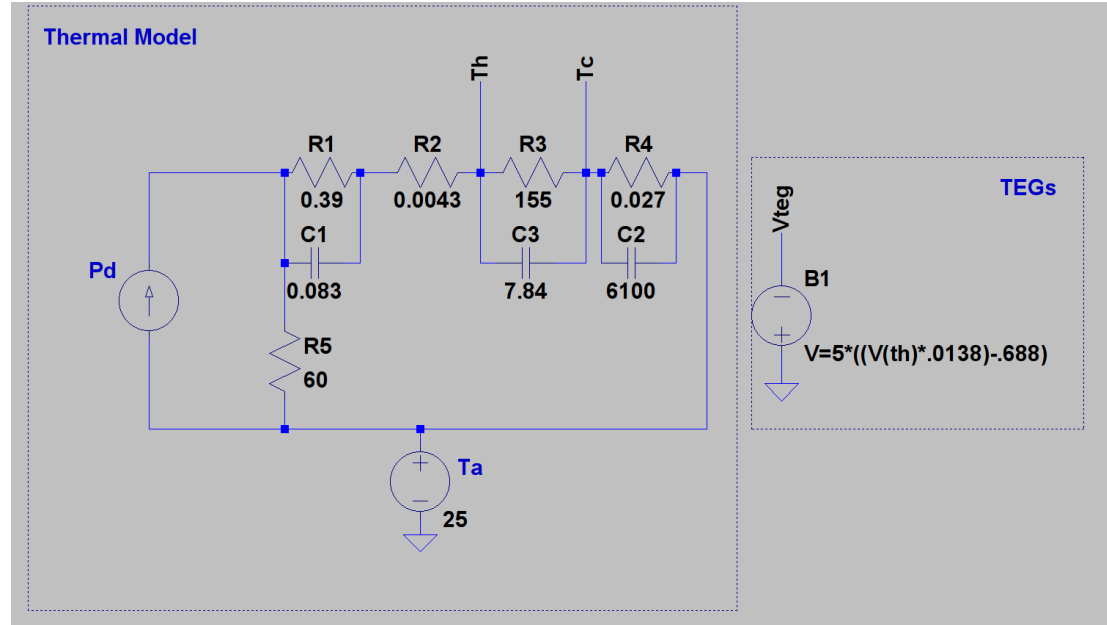
DESIGN A: CIRCUIT DESIGN

- D1: DS2-08
- M1: IXTH10N100D2
- TEGs: 1261G-7L31-04CL

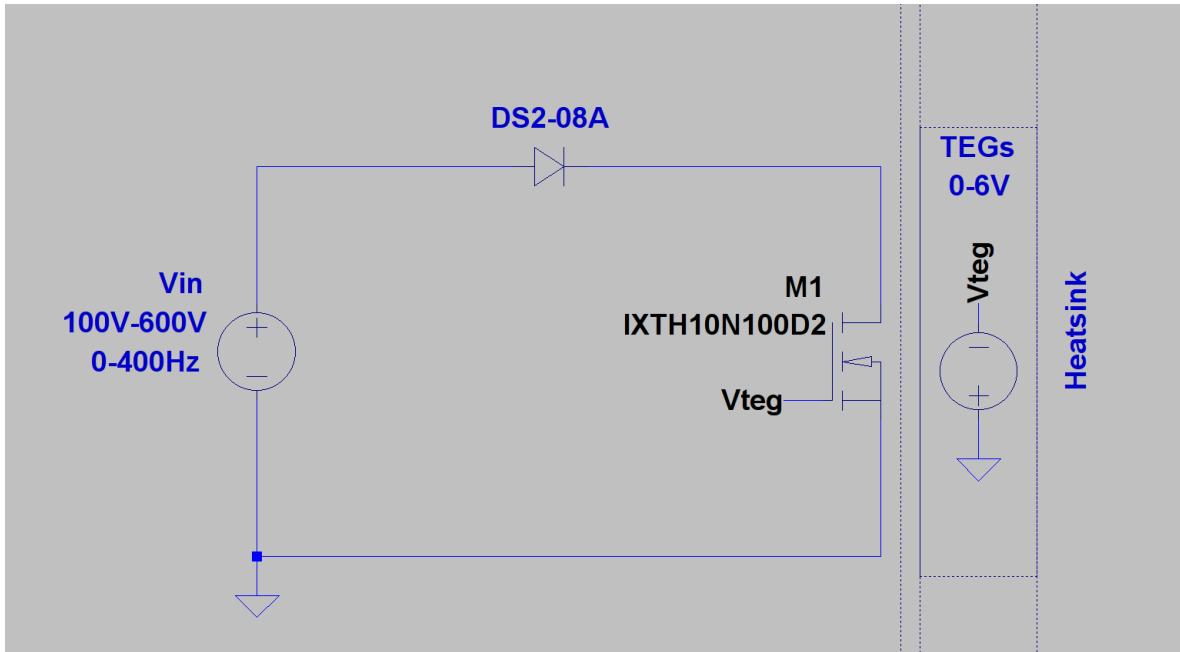


DESIGN A: THERMAL MODEL

- Thermal circuit analog
- Model heat flow from MOSFET to TEGs
- Temperatures throughout the circuit



DESIGN A: OPERATION



DESIGN A: PROS & CONS

Pros:

- Simple
- Cheap
- Self isolating
- Little design impact

Cons:

- Thermal considerations



DESIGN B: HALF-WAVE CONVERTER

- Take initial source 100-600 V (0-400Hz) to 5 Volts
- Provide controller enough power to start up



DESIGN B: CIRCUIT DESIGN

D1: DS2-08A

M1: 1XTT20N50D

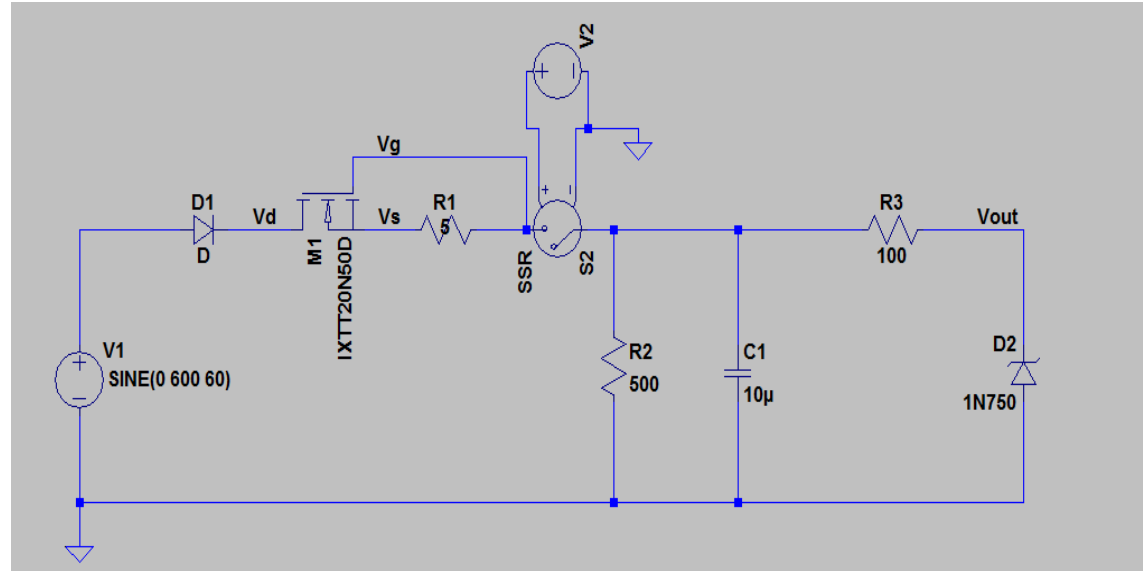
R1: RC1511KB

R2: RC125R1JB

R3: RC1101KB

C1: UVR1V100MDD1TA

D2: 1N750



DESIGN B: PROS & CONS

Pros:

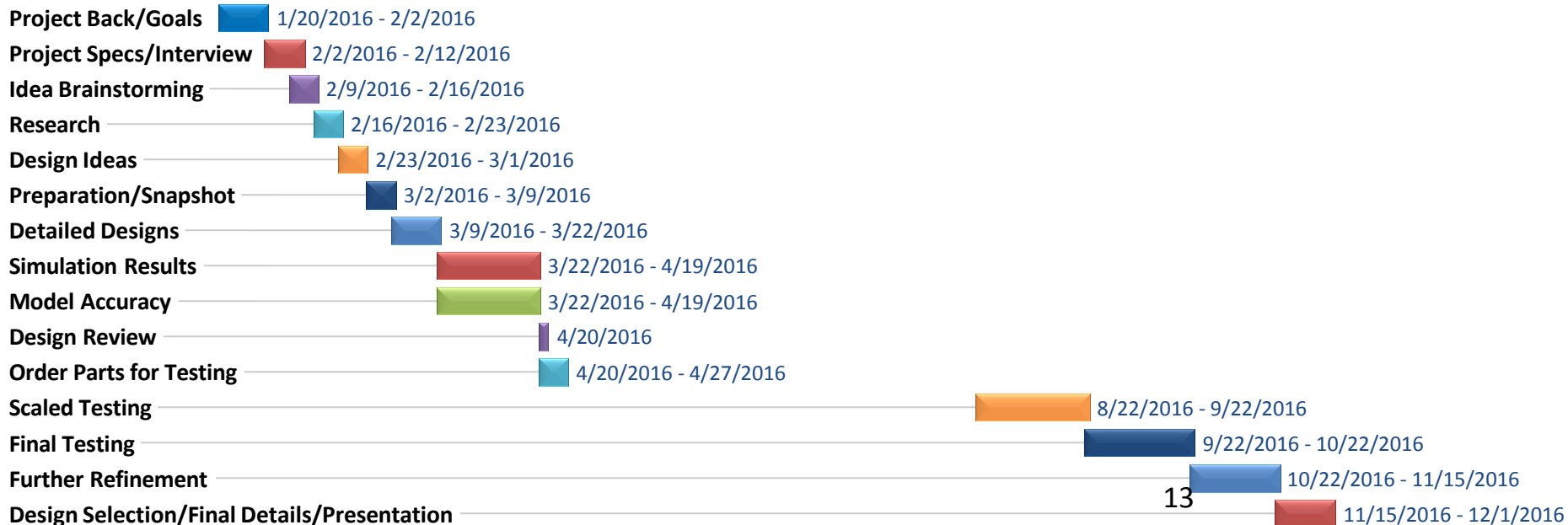
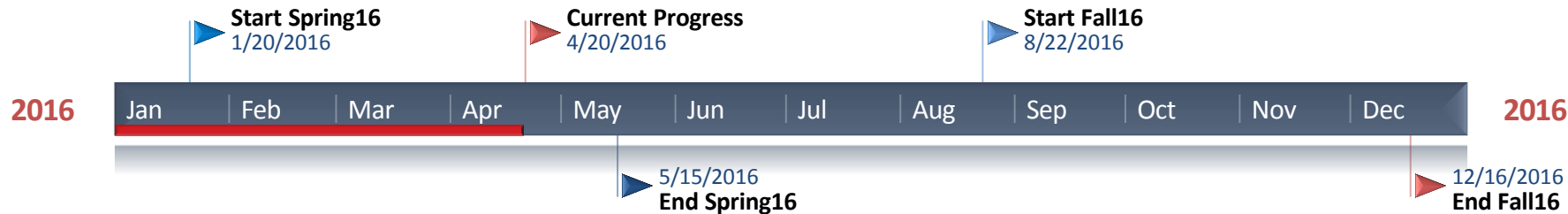
- Simple
- Cheap
- Few parts

Cons:

- Little protection
- Potential failure
- Inefficient



TIMELINE



SEMESTER 2



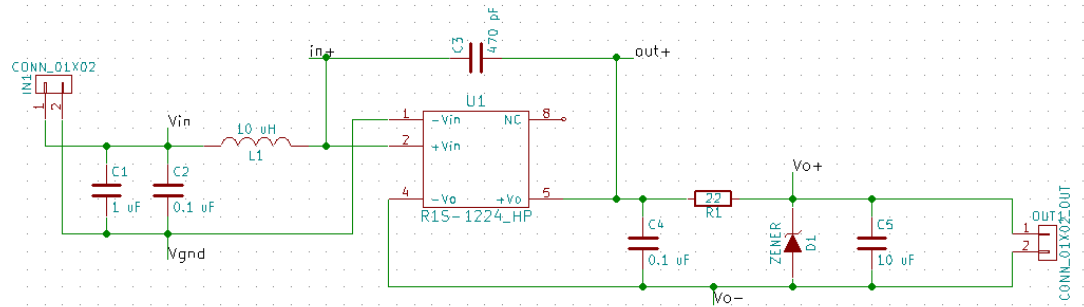
PROJECT RE-SCOPE

- TEG assumptions fell through
 - Based off of previous design team
 - Project determined non viable
 - Had to trash our previous designs
- New project direction
 - Design, build and test push-pull PCB board

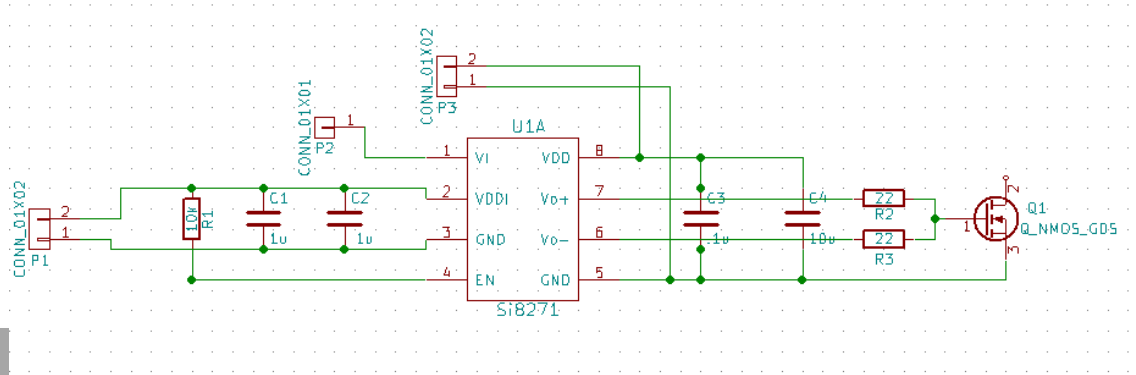


BOARD SCHEMATICS

- Board 1: DC-DC Converter

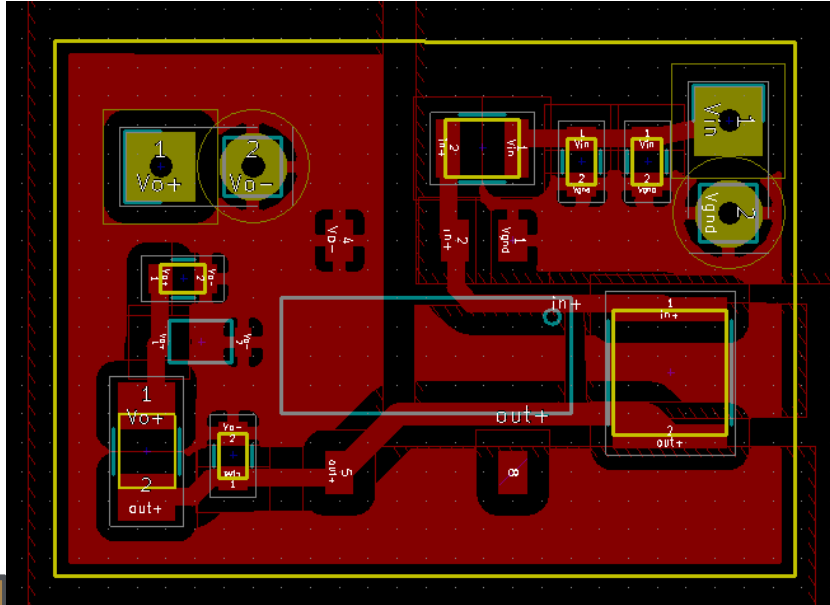


- Board 2: Gate Driver

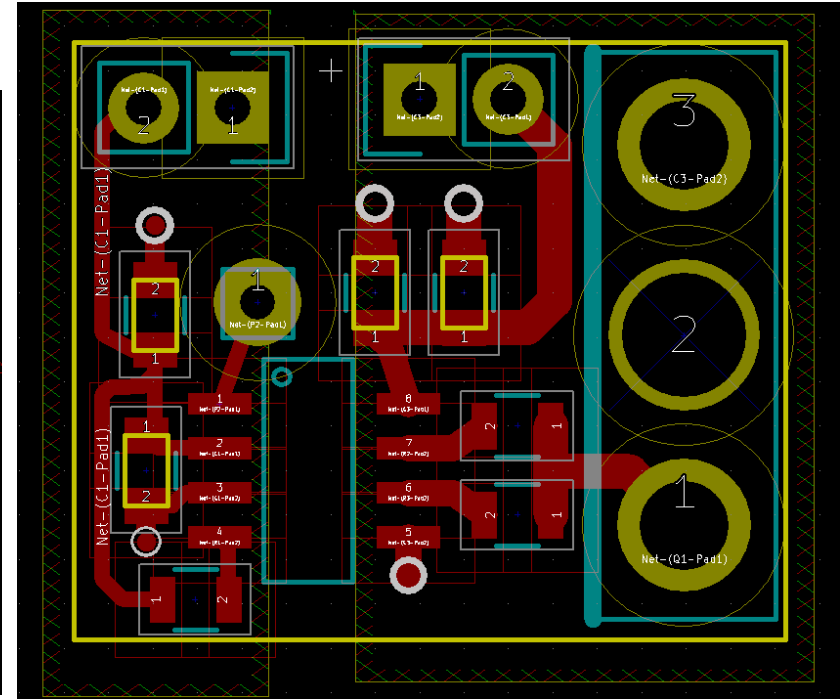


KICAD LAYOUTS

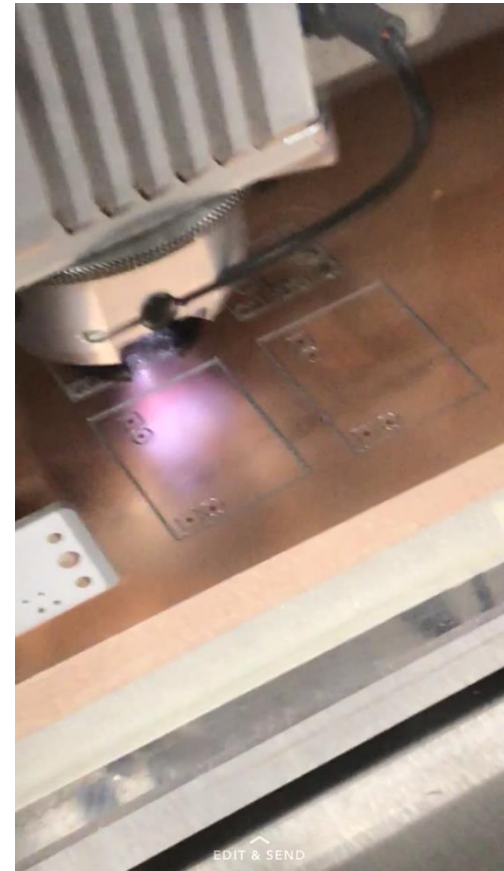
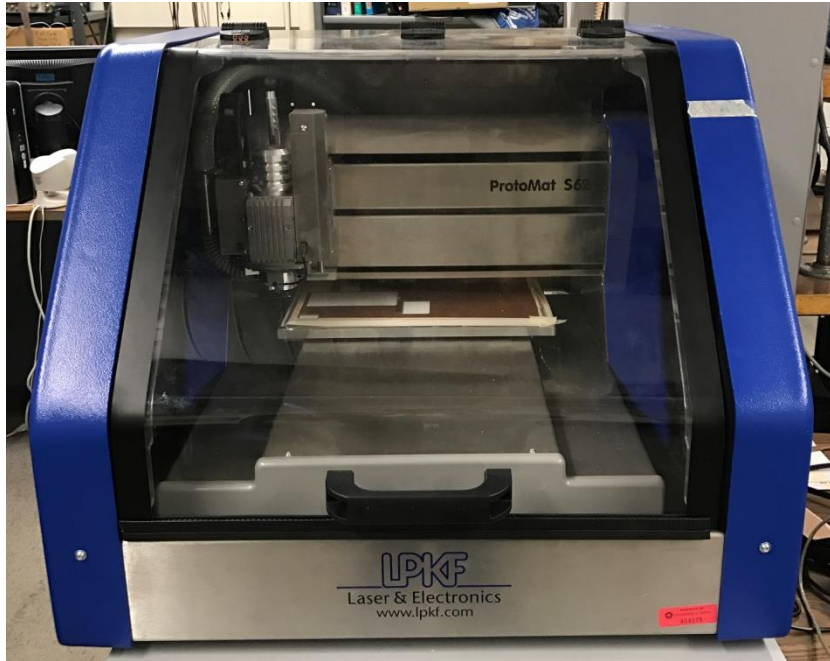
DC-DC Converter



Gate Driver

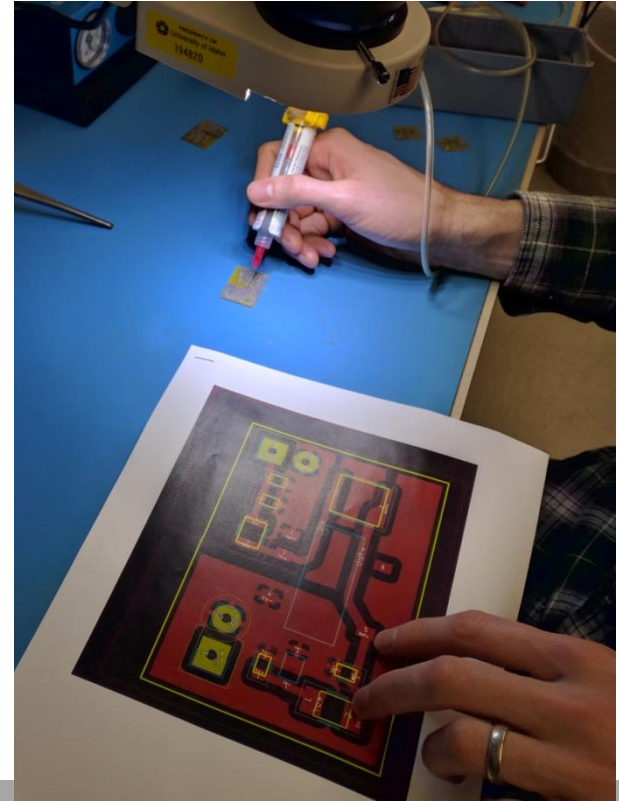
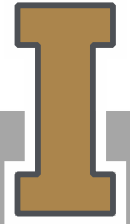


PCB MILLING

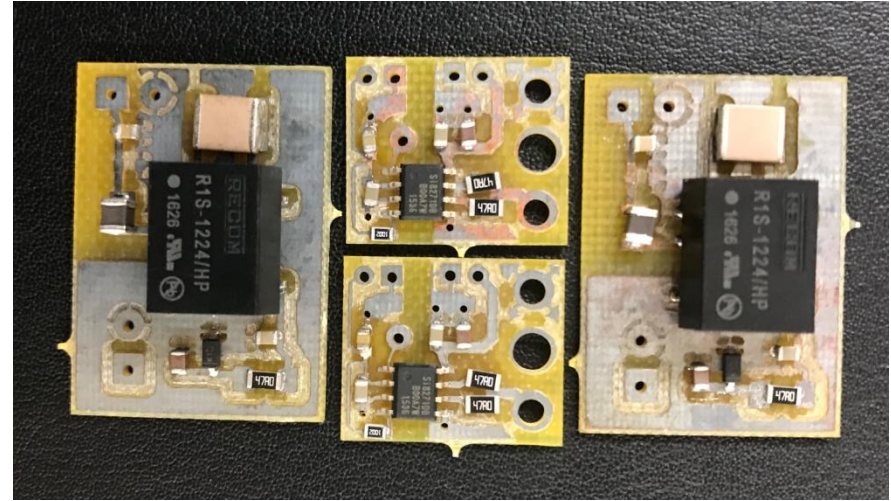
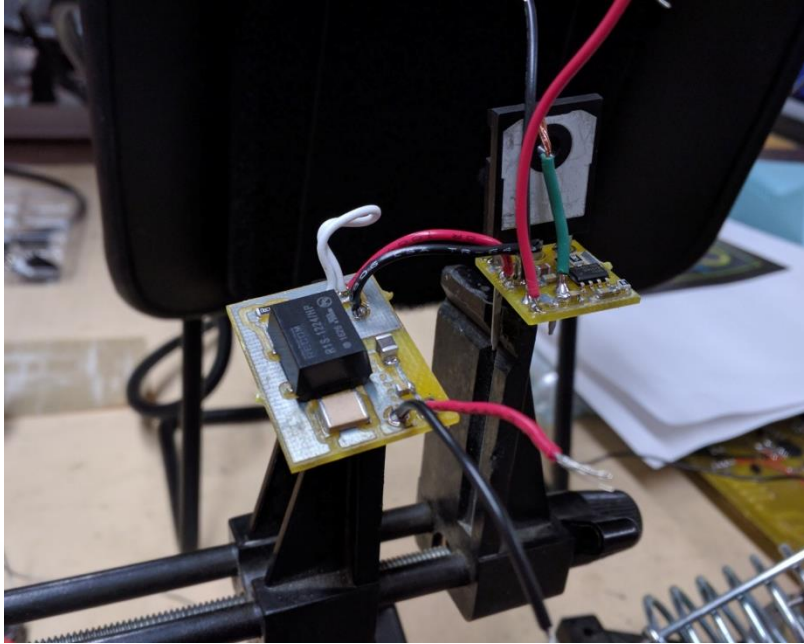


COMPONENT MOUNTING

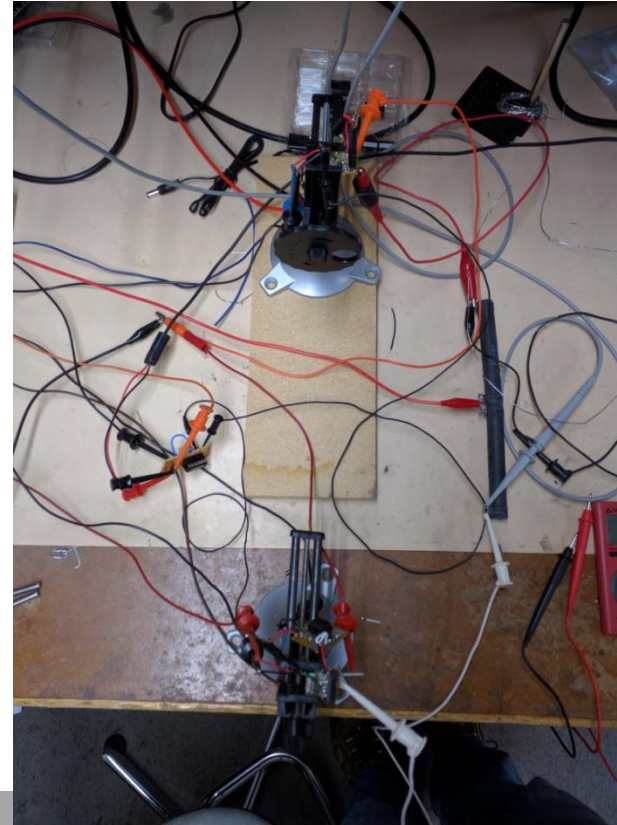
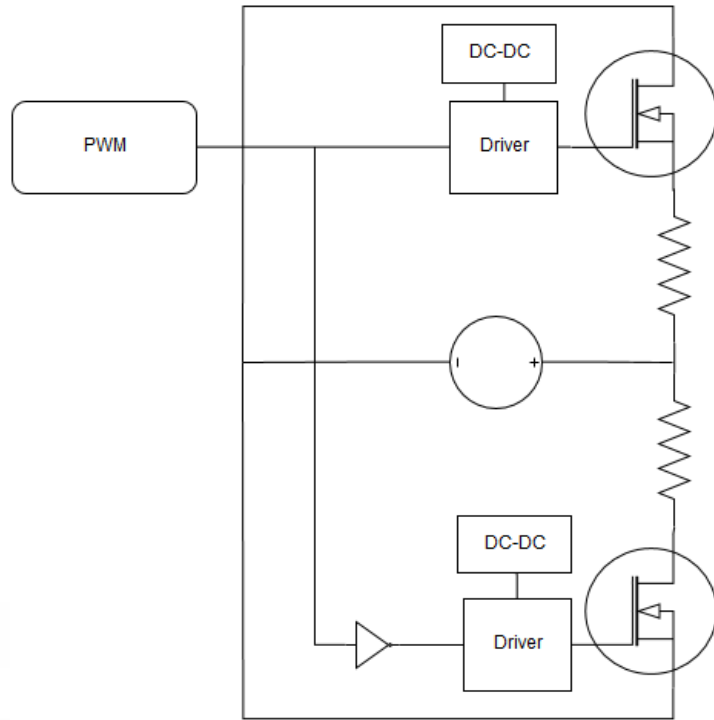
- Surface mount soldering
 - Solder paste
 - Heated air gun
- Challenges



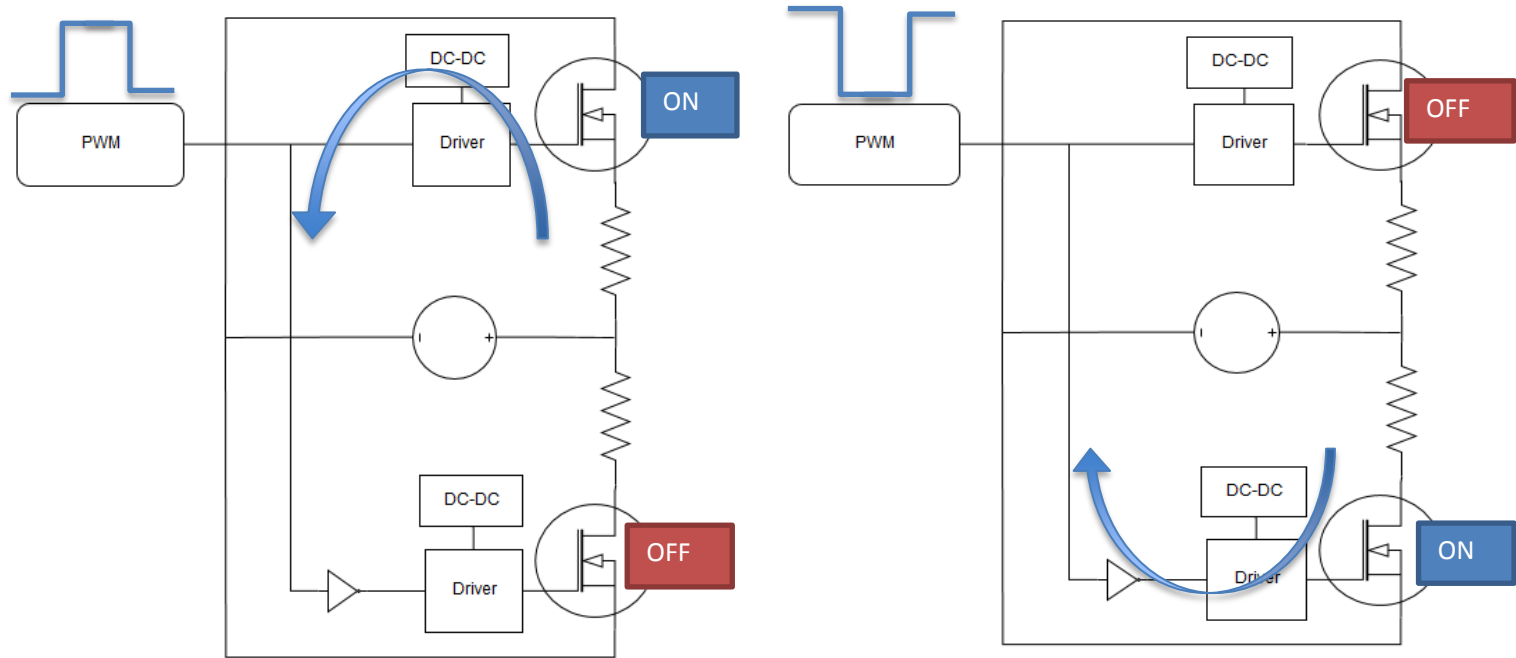
BOARD ASSEMBLY



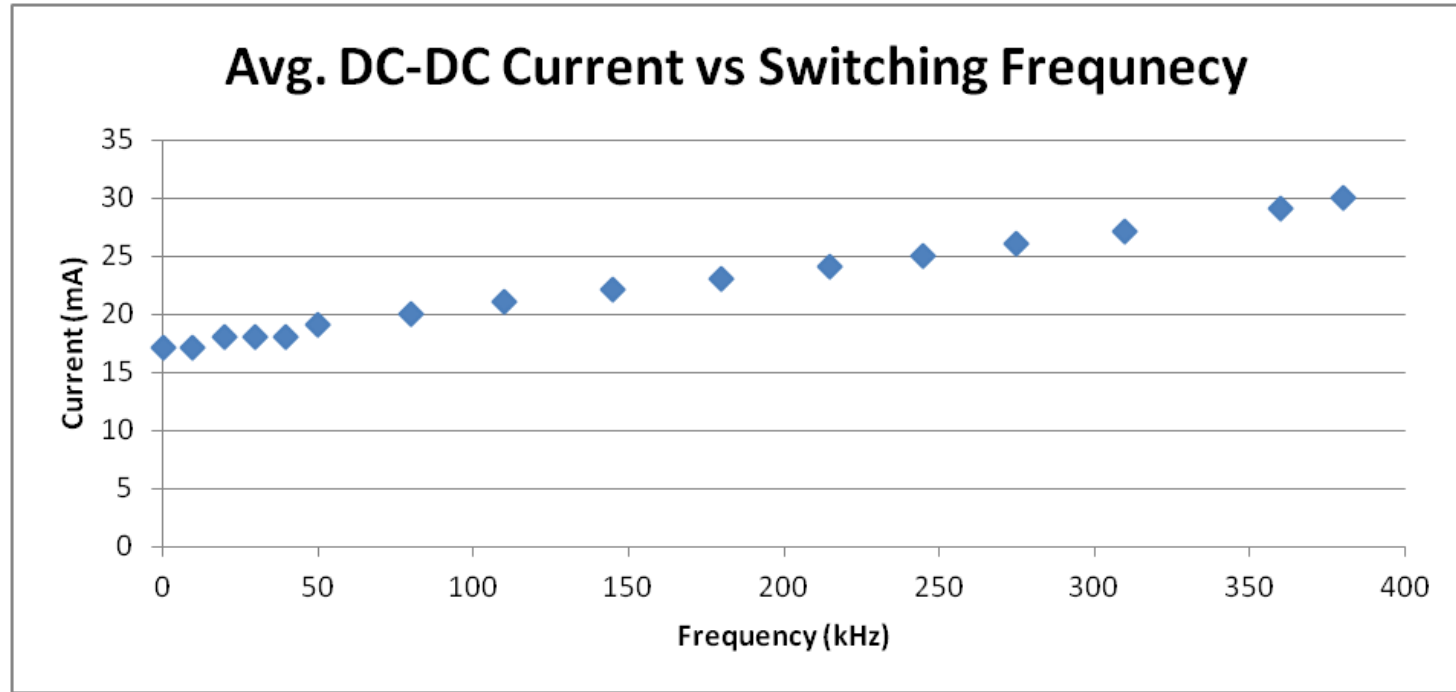
TEST SYSTEM



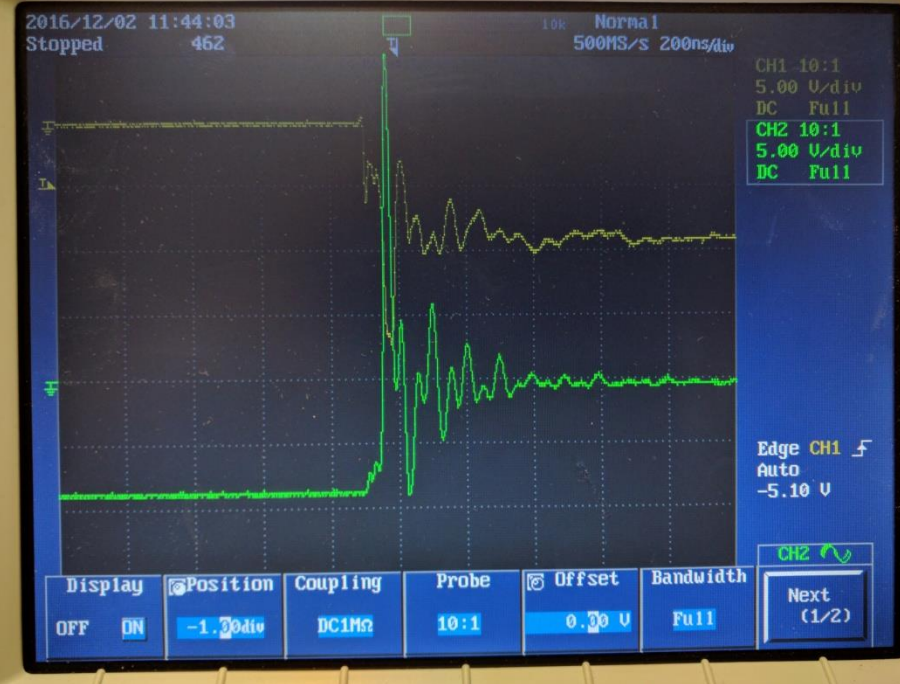
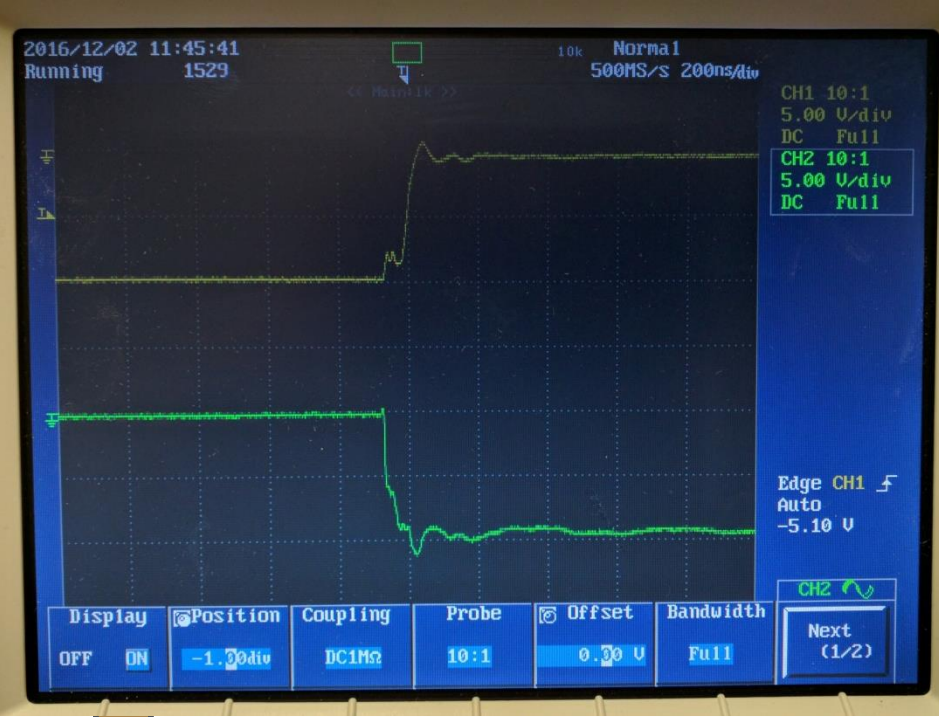
TEST CIRCUIT OPERATIONS



TEST RESULTS



TEST RESULTS



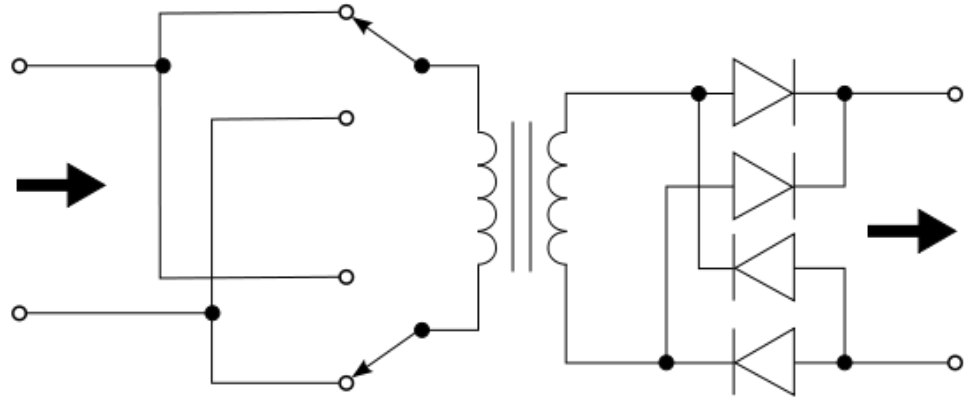
LOADING & CAPABILITY

- 20V p-p @ 1A
- High Load 20 Ohms: 500 kHz
- Low Load, 150 Ohms: 2 MHz



FUTURE WORK

- Gallium nitride
 - Higher frequency
 - Higher power density
- Center tap transformer addition
- Output filtering
- Higher power test equipment
- All-in-one board design



QUESTIONS?

